

1     CLAIMS:

2           1.     A plasma etching process comprising:  
3                 forming a carbon containing material over a semiconductor  
4                 substrate; and

5                 plasma etching the carbon containing material from the substrate  
6                 at a temperature of at least 400°C using a hydrogen or oxygen  
7                 containing plasma.

8  
9           2.     The plasma etching process of claim 1 wherein the  
10            temperature is at least 600°C.

11  
12           3.     The plasma etching process of claim 1 wherein the plasma  
13            contains hydrogen and oxygen.

14  
15           4.     The plasma etching process of claim 1 wherein the plasma  
16            contains oxygen.

17  
18           5.     The plasma etching process of claim 1 wherein the plasma  
19            contains hydrogen.

20  
21           6.     The plasma etching process of claim 5 wherein the hydrogen  
22            containing plasma is derived at least in part from H<sub>2</sub>.

1           7.     The plasma etching process of claim 5 wherein the hydrogen  
2 containing plasma is derived at least in part from  $\text{NH}_3$ .

3  
4           8.     The plasma etching process of claim 5 wherein the carbon  
5 containing material comprises a polymer.

6  
7           9.     The plasma etching process of claim 1 wherein the plasma  
8 is predominately comprised of hydrogen.

9  
10          10.    The plasma etching process of claim 1 further comprising  
11 after said plasma etching, further plasma etching using a gas comprising  
12 chlorine.

13  
14          11.    The plasma etching process of claim 10 further comprising  
15 after said plasma etching, further plasma etching using a gas comprising  
16 a mixture of chlorine and hydrogen.

17  
18          12.    The plasma etching process of claim 10 further comprising  
19 after said plasma etching, further plasma etching using a gas comprising  
20 a mixture of  $\text{Cl}_2$  and  $\text{H}_2$ .

21  
22          13.    The plasma etching process of claim 10 wherein the chlorine  
23 is derived at least in part from  $\text{Cl}_2$ .

14. The plasma etching process of claim 10 wherein the chlorine is derived at least in part from HCl.

15. A plasma etching process comprising:  
forming a masking layer over a substrate;  
patterning the masking layer to form openings therein;  
first etching material beneath the masking layer through the openings;

after the first etching, removing the masking layer from the substrate; and

after the removing and before subsequently depositing any material over the substrate, plasma etching the substrate at a temperature of at least 400°C.

16. The plasma etching process of claim 15 wherein the plasma comprises oxygen.

17. The plasma etching process of claim 15 wherein the plasma comprises hydrogen.

18. The plasma etching process of claim 17 wherein the hydrogen containing plasma is derived at least in part from H<sub>2</sub>.

1 19. The plasma etching process of claim 17 wherein the  
2 hydrogen containing plasma is derived at least in part from  $\text{NH}_3$ .

3  
4 20. The plasma etching process of claim 15 wherein the plasma  
5 is predominately comprised of hydrogen.

6  
7 21. The plasma etching process of claim 15 wherein the  
8 temperature is at least  $600^\circ\text{C}$ .

9  
10 22. The plasma etching process of claim 15 wherein the first  
11 etching leaves a residue at least partially over the substrate, the plasma  
12 etching removing the residue from the substrate.

13  
14 23. The plasma etching process of claim 15 comprising after the  
15 removing and before subsequently depositing any material over the  
16 substrate, conducting at least two plasma etchings using different reactive  
17 gas chemistries, one of the at least two plasma etchings being said  
18 plasma etching at a temperature of at least  $400^\circ\text{C}$ , another of the at  
19 least two plasma etchings being subsequent to the one and using a gas  
20 chemistry comprising chlorine.

21  
22 24. The plasma etching process of claim 23 wherein the another  
23 plasma etching is conducted at a temperature of at least  $400^\circ\text{C}$ .

1           25. A semiconductor plasma etching process comprising:  
2           first etching material from a substrate and forming an undesired  
3           residue at least partially over the substrate during the first etching; and  
4           after the first etching and before subsequently depositing any  
5           material over the substrate, plasma etching the undesired residue from  
6           the substrate.

7  
8           26. The plasma etching process of claim 25 wherein the first  
9           etching comprises dry etching.

10  
11           27. The plasma etching process of claim 25 wherein the first  
12           etching comprises wet etching.

13  
14           28. The plasma etching process of claim 25 wherein the residue  
15           comprises a carbon containing polymer.

16  
17           29. The plasma etching process of claim 25 wherein the residue  
18           is not a polymer.

19  
20           30. The plasma etching process of claim 25 wherein the plasma  
21           etching is conducted at a temperature of at least 400°C.

22  
23           31. The plasma etching process of claim 25 wherein the plasma  
24           etching is conducted at a temperature of at least 600°C.

1           32. The plasma etching process of claim 25 wherein the plasma  
2 etching is conducted substantially selective to remove the residue relative  
3 to all other exposed material of the substrate.

4  
5           33. The plasma etching process of claim 25 wherein the residue  
6 comprises a carbon containing polymer, and the plasma etching is  
7 conducted at a temperature of at least 400°C.

8  
9           34. The plasma etching process of claim 25 wherein the residue  
10 comprises a carbon containing polymer, and the plasma etching is  
11 conducted at a temperature of at least 600°C.

12  
13           35. A plasma etching process comprising:  
14 forming a photoresist layer over a semiconductor substrate;  
15 patterning the photoresist layer to form openings therethrough;  
16 dry etching a first layer immediately beneath the photoresist layer  
17 through the openings and forming a carbon containing polymer residue  
18 at least partially over the substrate during the first etching;

19           after the dry etching, removing the photoresist layer from the  
20 substrate; and

21           after the removing and before subsequently depositing any material  
22 over the substrate, plasma etching the carbon containing polymer residue  
23 from the substrate substantially selectively relative to the first layer.  
24

1           36. The plasma etching process of claim 35 wherein the plasma  
2 etching is conducted at a temperature of at least 400°C.

3  
4           37. The plasma etching process of claim 35 wherein the plasma  
5 etching is conducted at a temperature of at least 600°C.

6  
7           38. The plasma etching process of claim 35 wherein the plasma  
8 comprises oxygen.

9  
10          39. The plasma etching process of claim 35 wherein the plasma  
11 comprises hydrogen.

12  
13          40. The plasma etching process of claim 39 wherein the plasma  
14 is derived at least in part from  $H_2$ .

15  
16          41. The plasma etching process of claim 39 wherein the plasma  
17 is derived at least in part from  $NH_3$ .

1        42. A chemical vapor deposition process of depositing a material  
2 over a semiconductor substrate comprising:

3        positioning a semiconductor substrate within a plasma enhanced  
4 chemical vapor deposition reactor;

5        plasma etching the substrate within the reactor using a first gas  
6 chemistry; and

7        after the plasma etching, chemical vapor depositing a material  
8 over the semiconductor substrate within the reactor using a second gas  
9 chemistry without removing the substrate from the reactor between the  
10 etching and the depositing.

11  
12        43. The plasma etching process of claim 42 wherein the plasma  
13 etching and the depositing are conducted at subatmospheric pressure, the  
14 substrate not being exposed to atmospheric pressure intermediate the  
15 plasma etching and the depositing.

16  
17        44. The plasma etching process of claim 42 wherein the plasma  
18 etching is conducted at a temperature of at least 400°C.

19  
20        45. The plasma etching process of claim 42 wherein the plasma  
21 etching is conducted at a temperature of at least 600°C.

22  
23        46. The plasma etching process of claim 42 wherein the first  
24 chemistry comprises oxygen.



1           47. The plasma etching process of claim 42 wherein the first  
2 chemistry comprises hydrogen.

3  
4           48. The plasma etching process of claim 42 wherein the  
5 substrate has a residue formed at least partially thereover the result of  
6 previous processing, the plasma etching removing the residue from the  
7 substrate.

8  
9           49. The plasma etching process of claim 42 wherein the  
10 substrate has a carbon containing polymer formed at least partially  
11 thereover, the plasma etching removing the carbon containing polymer  
12 from the substrate.

13  
14           50. The plasma etching process of claim 42 wherein the  
15 substrate has a carbon containing polymer residue formed at least  
16 partially thereover the result of previous processing, the plasma etching  
17 removing the carbon containing polymer residue from the substrate.

18  
19           51. The plasma etching process of claim 42 comprising plasma  
20 etching the substrate within the reactor using another gas chemistry  
21 different from the first and second gas chemistries intermediate the  
22 plasma etching with the first gas chemistry and the depositing.

23

24

1           52. The plasma etching process of claim 51 wherein the another  
2 gas chemistry comprises chlorine.

3  
4           53. The plasma etching process of claim 52 wherein the another  
5 gas chemistry comprises hydrogen.

6  
7           54. A method of forming a conductive contact comprising:  
8 forming an insulative material over a silicon comprising substrate;  
9 forming an opening into the insulative material over a node  
10 location on the silicon comprising substrate to which electrical  
11 connection is desired;

12 first plasma etching within the opening using a gas chemistry  
13 comprising hydrogen and exposing silicon of the substrate to said plasma  
14 hydrogen;

15 after the first plasma etching, second plasma etching within the  
16 opening using a gas chemistry comprising chlorine; and

17 after the second plasma etching, forming a silicide material within  
18 the opening in contact with silicon of the substrate.

19  
20           55. The method of claim 54 wherein the silicide material is  
21 formed by refractory metal deposition and anneal.

22  
23           56. The method of claim 54 wherein the silicide material is  
24 formed by chemical vapor deposition of the silicide material.

1           57. The method of claim 54 wherein the gas chemistry  
2 comprising hydrogen comprises  $H_2$ .

3  
4           58. The method of claim 54 wherein the gas chemistry  
5 comprising chlorine comprises  $Cl_2$ .

6  
7           59. The method of claim 54 wherein the gas chemistry  
8 comprising chlorine comprises  $HCl$ .

9  
10          60. The method of claim 54 wherein the first plasma etching,  
11 the second plasma etching, and at least some of the silicide material  
12 forming all occur in the same chamber.